

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT (PCT Article 36 and Rule 70)

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| Applicant's or agent's file reference 413037 | FOR FURTHER ACTION | | See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416) |
| International application No. PCT/US 03/33522 | International filing date (day/month/year) 23.10.2003 | Priority date (day/month/year) 23.10.2002 | |
| International Patent Classification (IPC) or both national classification and IPC G01J1/42 | | | |
| Applicant THE TRUSTEES OF DARMOUTH COLLEGE et al. | | | |

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 8 sheets, including this cover sheet.

This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 3 sheets.

3. This report contains indications relating to the following items:
 - I Basis of the opinion
 - II Priority
 - III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
 - IV Lack of unity of invention
 - V Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
 - VI Certain documents cited
 - VII Certain defects in the international application
 - VIII Certain observations on the international application

| | |
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| Date of submission of the demand 12.05.2004 | Date of completion of this report 17.11.2004 |
| Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465 | Authorized Officer Jacquin, J Telephone No. +49 89 2399-8040 |



**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/US 03/33522

I. Basis of the report

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

Description, Pages

1-19 as originally filed

Claims, Numbers

1-25 as originally filed
26-46 received on 14.05.2004 with letter of 12.05.2004

Drawings, Sheets

1/8-8/8 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- the language of publication of the international application (under Rule 48.3(b)).
- the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- contained in the international application in written form.
- filed together with the international application in computer readable form.
- furnished subsequently to this Authority in written form.
- furnished subsequently to this Authority in computer readable form.
- The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- the description, pages:
- the claims, Nos.:
- the drawings, sheets:

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5. This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

| | | |
|---------------------|-------------|------------------------------------|
| Novelty (N) | Yes: Claims | 3-17,20,22-28,30,32-34,36-40,42-46 |
| | No: Claims | 1,2,18,19,21,29,31,35,41 |
| Inventive step (IS) | Yes: Claims | |
| | No: Claims | 3-17,20,22-28,30,32-34,36-40,42-46 |

| | | |
|-------------------------------|-------------|------|
| Industrial applicability (IA) | Yes: Claims | 1-46 |
| | No: Claims | |

2. Citations and explanations

see separate sheet

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Prior Art

Reference is made to the following documents:

D1: US4935618
D2: EP1041371
D3: EP903566
D4: GB2272763
D5: US5430546
D6: EP359360
D7: JP60196676

Section V

1- Objections as to lack of clarity (Art. 6 PCT)

The present application does not meet the requirements of article 6 PCT, because the independent claims are not clear. The reasons are the following :

- a)** Although claims 18 and 31 have been drafted as separate independent claims, they appear to relate effectively to the same subject-matter, and therefore lack conciseness.
- b)** Moreover, lack of clarity of the claims as a whole arises, since the plurality of independent claims makes it difficult, if not impossible, to determine the matter for which protection is sought, and places an undue burden on others seeking to establish the extent of the protection.
- c)** Method claims 10, 14, 43, 45 and 46 contain all the features of method claim 1, and should therefore be made dependent on the latter.
- d)** In claim 26, the phrase "... generating a laser beam into one the power splitter ..." is unclear and has been understood as meaning "... generating a laser beam into one arm of the power splitter ...". The same remark applies to claim 28.
- e)** In claim 40 it is not clear through which active area(s) the current flows (lines 23-24). Claim 40 has been understood to make reference to the arrangement shown on figure 1.

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- f) Claim 42 appears to be a use claim rather than an apparatus claim. It should therefore be redrafted accordingly.
- g) In claim 46, the expression "incident optical" (p. 25, l. 26) does not have a clear meaning, and has been understood as "incident optical radiation".

2- Objections as to lack of novelty (Art. 33(2) PCT)

Insofar as the claims can be understood (see the above clarity objections), the present application does not meet the requirements of Article 33(2) PCT, because the subject-matter of claims 1, 2, 18, 19, 21, 29, 31, 35 and 41 is not novel. The reasons are the following:

2- 1. Independent claims 1, 18, 31

Documents D1, D2 and D3 disclose a method for detecting changes in incident optical radiation (D1: abstract ; D2: col. 1, l. 13-16 ; D3: abstract) comprising the steps of

- driving current through one or more active areas of a detector (D1: fig. 1, photoelectric element 1 ; D2: fig. 3, diodes 1012, 1022, 1032...) while the incident optical radiation illuminates the active areas (D1: col. 1, l. 28-30 ; D2: col. 11, l. 19-26 ; D3: col. 8, l. 39-40), and
- sensing voltage across one or more of the active areas, a change in the voltage being indicative of the changes in incident optical radiation (D1: col. 1, l. 34-41 ; D2: col. 11, l. 43-54 ; D3: col. 8, l. 41-42).

Hence all the features of **claim 1** are already known either from D1 or D2 or D3.

Claims 18 and 31 are apparatus claims corresponding to claim 1, and the passages cited above for D1 and D2 describe the corresponding technical features. Claims 18 and 31 are therefore not novel.

2- 2. Dependent claims 2, 19, 21, 29, 35, 41

Claim 2 : In D1 and D2, an observation instrument is implicit, since the step of sensing a voltage necessarily involves an observation instrument.

Claim 19 : In D1 (resp. D2), +B1 (resp. element 1500) in figure 1 (resp. 3) is a constant voltage source (D1: col. 1, l. 26 ; D2: col. 11, l. 4-5).

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Claims 21, 35 : D3 mentions the well known technique of four point measurement (col. 8, l. 38-42).

Claim 29 : Input and output electrodes are explicitly mentioned in D3 (col. 8, l. 39-42) ; they are at least implicit in D1 and D2, since otherwise the devices would not function.

Claim 41 : In D3, the active areas form a two-dimensional array (matrix of bolometers).

3- Objections as to lack of inventive step (Art. 33(3) PCT)

The present application does not meet the requirements of Article 33(3) PCT, because the subject-matter of claims 3 to 17, 20, 22 to 28, 30, 32 to 34, 36 to 40, 42 to 46 does not involve an inventive step. The reasons are the following:

3- 1. Independent claims 10, 14, 43, 45, 46

Claims 10, 14, 43, 45

The detection principle of the methods described in these claims (driving current through the active areas of a detector and sensing voltage across these active areas) is already known from D1, D2 or D3. It is then obvious that this light detection principle can be used in a wide range of contexts, as soon as the investigated physical phenomena cause changes in their surrounding optical radiation fields. The measured quantities are then obviously related to said physical phenomena and represent the evolution of the observed physical phenomenon.

Examples of such phenomena are the motion of a surface (claims 10, 14) or the evolution in the relative positions or angles between two objects (claims 43, 45).

The general context of speckle-based surface motion detection (**claims 10, 14**) can be found in D4 (p. 2, l. 3-12 ; p. 4, l. 11-17 ; fig. 1, 20).

The general context of interference or diffraction based detection of the relative position (**claim 43**) or angles (**claim 45**) between two objects can be found in D5 (col. 2, l. 9 to col. 3, l. 55).

It would be obvious to the skilled person to combine the teachings of document D4 (resp. D5) with the particular detection principle taught in either D1, D2 or D3, according to circumstances.

Consequently, the subject-matter of claims 10, 14, 43 and 45 can not be considered as

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involving an inventive step.

Claim 46

In D2 (fig. 3), a plurality of active areas (1011, 1012, 1013...) are exposed to incident optical radiation. By reference to paragraph 2- 1. about claims 1, 18 and 31, the steps of driving current through two or more of these areas and sensing voltage across these areas are already disclosed in D2. The subject-matter of claim 45 seems to differ from the disclosure of D2 in that relative intensities of incident optical radiation are detected by means of voltage ratios between the different detected voltages corresponding to different active areas. This is however a trivial post-processing step for the skilled person, for whom the computation of voltage ratios is merely one of a plurality of straightforward solutions for comparing detected signals.

The subject-matter of claim 46 is therefore not inventive.

3- 2. Dependent claims

Claims 3 to 6, 8, 9, 11, 12, 15, 16 : These features describe well known standard possibilities for analyzing an electrical signal.

Claims 7, 13, 17 : A very wide range of physical phenomena gives rise to changes in the surrounding optical radiation fields, which are then detected by optical radiation detectors. Any change in optical radiation incident on the detector is then obviously interpreted as representing the evolution of the physical phenomenon to be observed. Examples of such phenomena are the motion of a surface (as described in D4) or the evolution in the relative positions or angles between two objects.

Claim 20 : This modulation technique is part of the common technical knowledge in the field for the purpose of improving signal to noise ratios.

Claim 22 : These features have already been employed for the same purpose in a similar device, see document D6 (col. 4, l. 5-46). It would be obvious to the person skilled in the art, namely when the same result is to be achieved, to combine the teachings of document D6 with the particular detection principle taught in either D1, D2 or D3, thereby arriving at a device according to claim 22.

Claims 23, 25 : In D6, multi-mode fibers are used.

Claim 24 : This is an extension to 2 dimensions of the optical fiber sensor known from D6 and comes within the scope of the customary practice followed by persons skilled in the art, especially as the advantages thus achieved can readily be foreseen.

Claim 26 : These features have already been employed for the same purpose in a

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similar device, see document D7 (abstract). It would be obvious to the person skilled in the art, namely when the same result is to be achieved, to combine the teachings of document D7 with the particular detection principle taught in either D1, D2 or D3, thereby arriving at a device according to claim 26.

Claim 27 : These are obvious possibilities for a power splitter.

Claim 28 : This is an extension to 2 dimensions of the optical fiber sensor known from D7 and comes within the scope of the customary practice followed by persons skilled in the art, especially as the advantages thus achieved can readily be foreseen.

Claims 30, 34 : In the four point measuring arrangement of D3, a collinear arrangement of the electrodes and the active areas is merely one of several straightforward design possibilities for the skilled person.

Claims 32, 33, 36 to 38 : The feature of the photoconductive material being a semiconductor is trivial in the field of radiation detectors. The characteristics listed in claim 33 are usual practice. Claims 36 to 38 merely list obvious possibilities for linking the electrodes to the active areas.

Claim 39 : The use of a chopper to block incident optical radiation on at least one of the active areas is well known, see D3 (col. 10, l. 37-41).

Claim 40 : The arrangement described in this claim (see clarity objection above) is the classical arrangement of a four point measurement system.

Claim 42 : The problem to be solved by this claim seems to be the guiding of the light towards the detector. Using optical fibers, for example one fiber per detector, is part of the customary practice in the art (see for example D7).

Claim 44 : This is trivial.

14.05.2004

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26. The sensor of claim 18, further comprising a laser, a power splitter, and an optical fiber coupled to the power splitter; the laser generating a laser beam into one the power splitter; the laser beam exiting the optical fiber, reflecting off of a surface and reentering the optical fiber to interfere with the laser beam within the optical fiber; the detector arranged to detect interfering laser radiation, as the incident optical radiation, from the power splitter, the voltage drop being indicative of motion of the surface.

27. The sensor of claim 26, the power splitter comprising one of a multi-mode fiber and bulk optics power splitter.

10 28. The sensor of claim 18, further comprising one or more lasers, an array of power splitters, and an array of optical fibers coupled to the power splitters; the lasers generating one or more laser beams into one the power splitters; the laser beams exiting the array of optical fibers, reflecting off of one or more surfaces and reentering the array of optical fibers to interfere with laser beams within the optical fibers; the active areas arranged as one of a two-dimensional and three-dimensional array to detect interfering laser radiation, as the incident optical radiation, from the power splitters, voltage drops across the active areas being indicative of motion of the surfaces.

15 29. The sensor of claim 18, further comprising input electrodes coupled to the source to drive the current through the active areas, and output electrodes coupled to the electronics to sense the voltage drop across the active areas.

30. The sensor of claim 29, the electrodes and active areas being collinear.

31. An optical radiation detector, comprising:
photoconductive material forming one or more active areas;
25 input electrodes for connection to a source to drive current through the active areas; and
output electrodes for connection to an observation instrument to sense voltage drop across one or more of the active areas.

30 32. The detector of claim 31, the photoconductive material comprising a semiconductor.

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33. The detector of claim 31, the photoconductive material comprising one of a III-V semiconductor and a II-VI semiconductor, the III-V semiconductor being defined by one or more components of the composition from the III column of the periodic table, and one or more components of the composition from the V column, 5 the II-VI semiconductor being defined by one or more components of the composition from the II column of the periodic table, and one or more components of the composition from the VI column.

34. The detector of claim 31, the active areas, input electrodes and output electrodes being collinear.

10 35. The detector of claim 31, the detector being configured for a four-point measurement.

36. The detector of claim 31, further comprising the photoconductive material disposed between the electrodes and the active areas.

15 37. The detector of claim 31, further comprising resistive material disposed between the electrodes and the active areas.

38. The detector of claim 31, further comprising semiconductive material disposed between the electrodes and the active areas.

39. The detector of claim 31, further comprising a mask to block incident optical radiation incident on at least one of the active areas.

20 40. The detector of claim 31, the active areas comprising at least three active areas, wherein a first one of the active areas separates a first input electrode from a first output electrode, and wherein a second one of the active areas separates a second input electrode from a second output electrode, such that current flows from the first input electrode through the active area and to the second input electrode, such 25 that the first input and output electrodes do not short-circuit, and such that the second input and output electrodes do not short-circuit.

41. The detector of claim 31, the active areas forming one of a two-dimensional and three dimensional array.

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42. The detector of claim 41, the two-dimensional and three dimensional array, is used to detect the output from a matching array of optical fibers.

43. A method for assessing relative position between two objects, comprising:

5 generating an interference or diffraction pattern dependent upon a distance between the two objects; and sensing changes in the interference or diffraction pattern to achieve optimal alignment between the objects by: driving current through one or more active areas of a detector while the 10 interference or diffraction pattern illuminates the active areas; and sensing voltage across one or more of the active areas, a change in the voltage being indicative of a change in the distance between the objects.

44. The method of claim 43, the step of generating comprising illuminating a gap between the objects with a laser.

15 45. A method for assessing relative angles between two objects, comprising:

generating an interference or diffraction pattern dependent upon an angular relationship between the two objects; and sensing changes in the interference or diffraction pattern to achieve optimal 20 alignment between the objects by: driving current through one or more active areas of a detector while the interference or diffraction pattern illuminates the active areas; and sensing voltage across one or more of the active areas, a change in the voltage being indicative of a change in the angular relationship between the 25 objects.

46. A method for detecting the relative intensities of incident optical, comprising:

driving current through two or more active areas of a detector while incident 30 optical radiation illuminates the active areas; and sensing voltage across the active areas, voltage ratios across the active areas being indicative of intensity ratios of the incident optical radiation.

Box No. VIII (iv) DECLARATION: INVENTORSHIP (only for the purposes of the designation of the United States of America)
The declaration must conform to the following standardized wording provided for in Section 214; see Notes to Boxes Nos. VIII, VIII (i) to (v) (in general) and the specific Notes to Box No. VIII (iv). If this Box is not used, this sheet should not be included in the request.

**Declaration of inventorship (Rules 4.17(iv) and 51bis.1(a)(iv))
for the purposes of the designation of the United States of America:**

I hereby declare that I believe I am the original, first and sole (if only one inventor is listed below) or joint (if more than one inventor is listed below) inventor of the subject matter which is claimed and for which a patent is sought.

This declaration is directed to the international application of which it forms a part (if filing declaration with application).

This declaration is directed to international application No. PCT/..... (if furnishing declaration pursuant to Rule 26(er)).

I hereby declare that my residence, mailing address, and citizenship are as stated next to my name.

I hereby state that I have reviewed and understand the contents of the above-identified international application, including the claims of said application. I have identified in the request of said application, in compliance with PCT Rule 4.10, any claim to foreign priority, and I have identified below, under the heading "Prior Applications," by application number, country or Member of the World Trade Organization, day, month and year of filing, any application for a patent or inventor's certificate filed in a country other than the United States of America, including any PCT international application designating at least one country other than the United States of America, having a filing date before that of the application on which foreign priority is claimed.

Prior Applications: 60/420,623, filed 23 October 2003.....

I hereby acknowledge the duty to disclose information that is known by me to be material to patentability as defined by 37 C.F.R. § 1.56, including for continuation-in-part applications, material information which became available between the filing date of the prior application and the PCT international filing date of the continuation-in-part application.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 101 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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Inventor's Signature: *Philip Heinz*

(if not contained in the request, or if declaration is corrected or added under Rule 26(er) after the filing of the international application. The signature must be that of the inventor, not that of the agent)

Date: 23 October 2003

(of signature which is not contained in the request, or of the declaration that is corrected or added under Rule 26(er) after the filing of the international application)

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(if not contained in the request, or if declaration is corrected or added under Rule 26(er) after the filing of the international application. The signature must be that of the inventor, not that of the agent)

Date: 23 October 2003

(of signature which is not contained in the request, or of the declaration that is corrected or added under Rule 26(er) after the filing of the international application)

This declaration is continued on the following sheet, "Continuation of Box No. VIII (iv)".